

REMARKS

Claims 1-6, 17-19, and 40-58 were pending in the above-identified application when last examined. This response amends the claims as indicated above and in particular cancels claims 43, 47, and 50, amends claims 1-4, 17-19, 40-42, 44-46, 48, 49, 51, and 56, and adds claims 59-62.

Claims 17-19 and 40 were rejected under 35 U.S.C. § 112, second paragraph. Claim 17 and 19 in particular were rejected for reciting "the defect" after previous references to a point defect and a line defect. Applicants have amended claims 17 and 19 to better distinguish which defect is recited. Claim 18 and 40 were rejected under 35 U.S.C. § 112 as inherently containing the deficiencies of base claim 17. In view of the above amendments, Applicants request reconsideration and withdrawal of the rejection under 35 U.S.C. § 112.

Claims 1 and 2 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Pat. No. 4,941,205 (Horst). Applicants respectfully traverse the rejection.

Independent claim 1 distinguishes over Horst at least by reciting, "a first circuit unit containing a first electronic circuit and a plurality of modulators, wherein ... each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit" and by reciting, "a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein ... each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals."

Horst is concerned with avoiding the failure mechanisms such as wear, corrosion, and other damage of electrical terminals or contacts used for temporary connections of relatively large scale electrical systems. To avoid these problems, Horst transmits optical signals representing serial data streams and uses two such optical signals for bidirectional communications. Horst fails to disclose or suggest employing a plurality of modulators to modulate respective components of an optical signal.

In accordance with an aspect of the invention, many separate signals can be encoded in a multi-component optical signal that can be transmitted on a single waveguide. This permits space savings when compared to a traditional interconnect system that normally requires separate terminals and/or traces for each electrical signal. The space savings is particularly critical for highly integrated circuits and nanoscale

devices. Horst is directed to optical communications to avoid problems with electrical contact but not to reduce the size of interconnect systems, and Horst fails to disclose or suggest the advantages of employing optical signals with separately modulated components. Accordingly, claim 1 and claim 2, which depends from claim 1 are patentable over Horst.

For the above reasons, Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 102.

Claims 17 and 18 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Pat. No. 6,310,991 (Koops). Applicants respectfully traverse the rejection.

Claim 17 distinguishes over Koops at least by reciting, "An interface for input/output to/from an electronic integrated circuit," in which "the electrical elements produce electrical input signals of the electronic integrated circuit from respective optical signals having the wavelengths resonant with the adjacent point defects" and "the modulators respectively respond to electrical output signals of the electronic integrated circuit to modulate optical signals respectively having the wavelengths that are resonant with the adjacent point defects."

Koops is directed to optical circuits made with photonic crystals. For one embodiment, Koops discloses "laterally emerging light of different wavelength ranges is capable of being focused on different locations of a parallel-extending photonic crystal." See Koops, column 2, lines 35-37. Koops fails to disclose or suggest signal input or output of an electronic integrated circuit and particularly fails to disclose or suggest transformations between optical signals and electrical signals of an electronic integrated circuit. Accordingly, claim 17 is patentable over Koops.

Claim 18 depends from claim 17 and is patentable over Koops for at least the same reasons that claim 17 is patentable over Koops.

For the above reasons, Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 102.

Claims 17 and 18 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Pat. App. Pub. No. 2003/0142719 (Fan). Applicants respectfully traverse the rejection.

Claim 17 distinguishes over Fan at least by reciting, "An interface for input/output to/from an electronic integrated circuit," in which "the electrical elements produce electrical input signals of the electronic integrated circuit from respective optical signals having the wavelengths resonant with the adjacent point defects" and "the modulators

respectively respond to electrical output signals of the electronic integrated circuit to modulate optical signals respectively having the wavelengths that are resonant with the adjacent point defects.”

Fan like Koops is directed to optical circuits and Fan particularly is directed to creating asymmetric shapes in microcavity structures that can be used as drop filters. However, such disclosure of general principles of creating optical circuits fails to suggest use of such optical circuits in interfaces for input or output to/from electronic integrated circuits. Accordingly, Fan fails to suggest an interface for input/output to/from an electronic integrated circuit as recited in claim 17. Accordingly, claim 17 and claim 18, which depends from claim 17 are patentable over Fan.

For the above reasons, Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 102.

Claims 17, 19, 40, and 51-57 were rejected under 35 U.S.C. § 102(b) as anticipated by U.S. Pat. App. Pub. No. 2002/0009277 (Noda). Applicants respectfully traverse the rejection.

Independent claim 17 distinguishes over Noda at least by reciting, “An interface for input/output to/from an electronic integrated circuit,” in which “the electrical elements produce electrical input signals of the electronic integrated circuit from respective optical signals having the wavelengths resonant with the adjacent point defects” and “the modulators respectively respond to electrical output signals of the electronic integrated circuit to modulate optical signals respectively having the wavelengths that are resonant with the adjacent point defects.”

Noda is primarily directed to optical circuits and particularly to waveguides and wavelength demultiplexers formed in two-dimensional photonic crystal structures. Noda does mention that optical signals separated by a demultiplexer can be converted to electrical signals. In particular, paragraph [0065] of Noda describes, “the photonic crystal structure may be integrated with semiconductor devices having a photoelectric conversion function, for example, photodiode arrays 45 to 47 as shown in FIG. 8. With this construction, light or electromagnetic radiation delivered from the point defects 42 to 44 in the orthogonal direction can be directly converted into electrical signals within very small areas.” However, Noda fails to suggest use of such signal demultiplexing and conversion in “An interface for input/output to/from an electronic integrated circuit,” as recited in claim 17. The only electrical elements that Noda suggests integrating with a photonic crystal is “semiconductor devices having a photoelectric conversion function.” Noda fails

to suggest integrating or using photonic crystals as interfaces for electronic integrated circuits.

Noda further fails to disclose or suggest modulators as recited in claim 17. Modulators can enable an interface to handle output signals of an electronic integrated circuit, but Noda is silent regard modulators or interfaces for electronic integrated circuits.

Accordingly, claim 17 is patentable over Noda.

Claims 19 and 40 depend from claim 17 and are patentable over Noda for at least the same reasons that claim 17 is patentable over Noda.

Independent claim 51 distinguishes over Noda at least by reciting, "An interface of an electronic integrated circuit, ... wherein the plurality of electrical elements respectively implement transformations between the plurality of frequency components and a plurality of electrical signals of the electronic integrated circuit." As noted above, Noda discloses optical demultiplexing and conversion of optical signals to electrical signals, but Noda fails to suggest use of such in an interface of an electronic integrated circuit. Accordingly, claim 51 is patentable over Noda.

Claims 52-57 depend from claim 51 and are patentable over Noda for at least the same reasons that claim 51 is patentable over Noda.

For the above reasons, Applicants request reconsideration and withdrawal of the rejection under 35 U.S.C. § 102.

Claim 3 was rejected under 35 U.S.C. § 103(a) as unpatentable over Horst in view of U.S. Pat. No. 6,804,283 (Scherer) and U.S. Pat.App. Pub. No. 2004/0150873 (Pearsall). Applicants respectfully traverse the rejection.

Claim 3 depends from claim 1, which is patentable over Horst for at least the reasons given above. In particular, Horst discloses systems using serial data streams but fails to disclose or suggest an interconnect system or using multiple components of an optical signal for multiple input or output signals. The Examiner cites Scherer and Pearsall for disclosing photonic crystals and components such as modulators in photonic crystals. However, the combination of Horst, Scherer, and Pearsall fails to provide any suggestion or motivation for uses of photonic crystals or a multi-component optical signal in the system of Horst.

Claim 3 further recites, "a photonic bandgap crystal, wherein each of the modulators comprises a defect within the photonic bandgap crystal and an electrode adjacent to the defect, wherein the defect acts as a resonator for the corresponding component of the first optical signal and has an optical property that varies with a voltage

applied to the electrode.”

The combination of Horst, Scherer, and Pearsall fails to suggest combining the photonic crystal structures of Scherer or Pearsall with the communication system of Horst. In particular, Horst is directed to the communication between data units of a size that differs significantly from the scale of photonic crystals. For example, Horst at column 3, lines 39-41 describes, “Each of the data processing circuits 15 and 21 may include, for example, associated memory, microprocessor, keyboard and display units.” Accordingly, Horst describes communication between macro-size systems, not systems that can be integrated with photonic crystals.

Claim 3 is thus patentable over the combination of Horst, Scherer, and Pearsall.

For the above reasons, Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 103.

Claims 4 and 46-49 were rejected under 35 U.S.C. § 103(a) as unpatentable over Horst in view of Scherer and Noda. Claim 47 is canceled. Applicants respectfully traverse the rejection of claims 4, 46, 48, and 49.

Claims 4, 46, 48, and 49 depend from claim 1, which is patentable over Horst for at least the reasons give above. The Examiner cites Scherer and Noda for disclosing photonic crystals and components such as modulators in photonic crystals. Noda further describes demultiplexing components of an optical signal. However, the combination of Horst, Scherer, and Noda fails to suggest using a multi-component optical signal in the communication system of Horst because the combination provides no indication of how or why the demultiplexing of Noda would be applied in the communication system of Horst.

Claims 4 and 48 further recite structures including photonic crystals. As indicated above, the combination provides no suggestion of combining the large-scale communication system of Horst with the photonic crystal structures of Scherer and Noda.

For the above reasons, claims 4, 46, 48, and 49 are patentable over the combination of Horst, Scherer, and Noda, and Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 103.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as unpatentable over Horst. Applicants respectfully traverse the rejection.

Claim 5 distinguishes over Horst by reciting, “the first circuit unit is integrated on a first chip and the second circuit unit is integrated on a second chip.” In contract, Horst is directed to large scale systems such as those including keyboards and monitors.

Applicants submit that the technical requirements for interconnections of integrated circuit are so different from those of communications between large-scale systems that Horst would not have led one of ordinary skill in the art to believe that the communication system of Horst was suitable for interconnection of integrated circuits. Accordingly, claim 5 is patentable over Horst.

Claim 6 depends from claim 5 and is patentable over Horst for at least the same reasons that claim 5 is patentable over Horst.

For the above reasons, Applicants request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103.

Claims 41-45 and 50 were rejected under 35 U.S.C. § 103(a) as unpatentable over Horst in view of Scherer, Pearsall, and Noda. Claims 43 and 50 are canceled. Applicants respectfully traverse the rejection of claims 41, 42, 44, and 45.

Claims 41, 42, 44, and 45 depend from claim 1 which is patentable over the combination of Horst, Scherer, Pearsall, and Noda at least for reciting, "An interconnect system comprising: a first circuit unit containing a first electronic circuit and a plurality of modulators, wherein: ... each modulator is controlled by a corresponding one of the electrical output signals and is capable of modulating a corresponding component of a first optical signal output from the first circuit unit; and a second circuit unit containing a second electronic circuit and a plurality of detectors, wherein: ... each detector is capable of detecting modulation of a corresponding one of the components of the first optical signal to extract a corresponding one of the input signals."

The combination of Horst, Scherer, Pearsall, and Noda fail to fairly suggest an interconnect system using multi-component optical signals for bidirectional communications. In particular, Horst discloses a communications system that uses serial data streams for communication between large systems. Scherer, Pearsall, and Noda disclose photonic crystal structures, and the combination of Horst, Scherer, Pearsall, and Noda fails to suggest combining such structures in a large scale communication system. Even if such combination were made, the combination fails to suggest how the demultiplexing of Noda might be employed in the communication system of Horst. Accordingly, claim 1 and claims 41, 42, 44, and 45 are patentable over Horst, Scherer, Pearsall, and Noda.

For the above reasons, Applicants request reconsideration and withdrawal of this rejection under 35 U.S.C. § 103.

Claim 58 was rejected under 35 U.S.C. § 103(a) as unpatentable over Noda in view of Pearsall. Applicants respectfully traverse the rejection.

Claim 58 depends from claim 51, which distinguishes over the combination of Noda and Pearsall at least by reciting, "An interface of an electronic integrated circuit, ... wherein the plurality of electrical elements respectively implement transformations between the plurality of frequency components and a plurality of electrical signals of the electronic integrated circuit." Noda and Pearsall are directed to manipulation of optical signals and do not suggest an interface for an electronic circuit as recited in claim 51. In particular, as noted above, Noda discloses optical demultiplexing and conversion of optical signals to electrical signals, but Noda fails to suggest use of such in an interface of an electronic integrated circuit. Instead, Noda discloses optical circuits and manipulation of optical signals. Pearsall similarly is directed to modulating optical signals for optical communication but fails to suggest an interface for an electronic integrated circuit. Accordingly, claim 51 is patentable over Noda and Pearsall whether considered separately or in combination, and claim 58, which depends from claim 51, is patentable over Noda and Pearsall for at least the same reasons.

For the above reasons, Applicants request reconsideration and withdrawal of the rejection under 35 U.S.C. § 103.


New claims 59-62 depend from claim 1 and are patentable for at least the same reasons that claim 1 is patentable.

For the above reasons, Applicants respectfully request allowance of the application including claims 1-6, 17-19, 40-42, 44-46, 48, 49, and 51-62.

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